

PLIB micro-oscillation mechanism, in relation to the field of view (FOV) of each image detection element in the IFD subsystem of the PLIIM-based system;

Fig. ~~4H25C1~~ 1I25C1 is a perspective view of a PLIIM-based system of the present invention embodying an speckle-pattern noise reduction subsystem, comprising (i) an image formation and detection (IFD) module mounted on an optical bench and having a linear (1D) CCD image sensor with vertically-elongated image detection elements characterized by a large height-to-width (H/W) aspect ratio, (ii) a pair of planar laser illumination modules (PLIMs) mounted on the optical bench on opposite sides of the IFD module, and (iii) a 2-D PLIB micro-oscillation mechanism arranged with each PLIM, and employing a micro-oscillating cylindrical lens array as shown in Figs. 1I6A through 1I6B and a micro-oscillating PLIB reflecting element configured together as shown as an optical assembly for the purpose of micro-oscillating the PLIB laterally along its planar extent as well as transversely along the direction orthogonal thereto, so that during illumination operations, the PLIB transmitted from each PLIM is spatial phase modulated along the planar extent thereof as well as along the direction orthogonal (i.e. transverse) thereto, causing numerous substantially different time-varying speckle-noise patterns to be produced at the vertically-elongated image detection elements of the IFD Subsystem during the photo-integration time period thereof, which are temporally and spatially averaged during the photo-integration time period of the image detection array, thereby reducing the RMS power level of speckle-noise patterns observed at the image detection array;

On Page 93, delete the seventh paragraph as follows:

~~Fig. 1V5 is a schematic representation of a presentation type bar code symbol reading system embodying the PLIIM-based subsystem of Fig. 1V1;~~

On Page 110, amend the seventh paragraph as follows:

Figs. 18A, 18B-1 and ~~18B2~~ 18B-2, taken together, set forth a real-time camera control process that is carried out within the camera control computer employed within the PLIIM-based systems of Fig. 11, wherein the camera control computer automatically processes the received time-stamped data sets and generates real-time camera control signals that drive the focus and zoom lens group translators within a high-speed auto-focus/auto-zoom digital camera subsystem (i.e. the IFD module) so that the camera subsystem automatically captures digital images having (1) square pixels (i.e. 1:1 aspect ratio) independent of package height or velocity, (2)

significantly reduced speckle-noise levels, and (3) constant image resolution measured in dots per inch (DPI) independent of package height or velocity;

On Page 114, amend paragraph 4 as follows:

~~Fig. 30 is~~ Figs. 30-1 through 30-4, taken together, set forth a schematic representation of the camera-based object identification and attribute acquisition subsystem of Fig. 27, illustrating the system architecture of the slave units in relation to the master unit, and that (1) the package height, width, and length coordinates data and velocity data elements (computed by the LDIP subsystem within the master unit) are produced by the master unit and defined with respect to the global coordinate reference system, and (2) these package dimension data elements are transmitted to each slave unit on the data communication network, converted into the package height, width, and length coordinates, and used to generate real-time camera control signals which intelligently drive the camera subsystem within each slave unit, and (3) the package identification data elements generated by any one of the slave units are automatically transmitted to the master slave unit for time-stamping, queuing, and processing to ensure accurate package dimension and identification data element linking operations in accordance with the principles of the present invention;

On Page 138, amend the second and third paragraphs as follows:

~~Fig. 69A is~~ Figs. 69A1 through 69A3 set forth a schematic block system diagram of a second illustrative embodiment of the airport security system of the present invention shown comprising (i) a passenger screening station or subsystem including PLIIM-based object identification and attribute acquisition subsystem, (ii) a baggage screening subsystem including PLIIM-based object identification and attribute acquisition subsystem, an RDID object identification subsystem, a x-ray scanning subsystem, and pulsed fast neutron analysis (PFNA) explosive detection subsystems (EDS), (iii) a internetworked passenger and baggage attribute relational database management subsystems (RDBMS), and (iv) automated data processing subsystems for operating on co-indexed passenger and baggage data elements stored therein, for the purpose of detecting breaches of security during and after passengers and baggage are checked into an airport terminal system;

Fig. 69B1 through 69B3, taken together, set forth a flow chart illustrating the steps involved in a second illustrative embodiment of the airport security method of the present invention carried out using the airport security system shown in ~~Fig. 69A~~ Figs. 69A1 through 69A3;

On Page 217, amend the first paragraph as follows:

In Figs. ~~1125C1~~ 1125C1 and 1125C2, there is shown a PLIIM-based system of the present invention 885 having speckle-pattern noise reduction capabilities embodied therein, which comprises: (i) an image formation and detection (IFD) module 861 mounted on an optical bench 862 and having a linear (1D) CCD image sensor 863 with vertically-elongated image detection elements 864 characterized by a large height-to-width (H/W) aspect ratio; (ii) a PLIA comprising a pair of planar laser illumination modules (PLIMs) 865A and 865B mounted on the optical bench on opposite sides of the IFD module; and (iii) a 2-D PLIB micro-oscillation mechanism 886 arranged with each PLIM in an integrated manner.

On Page 295, amend paragraphs 2, 3 and 5 as follows:

As will be described in greater detail hereinafter, the camera control computer 22 controls the auto-focus/auto-zoom digital camera subsystem 3'' in an intelligent manner using the real-time camera control process illustrated in Figs. 18A, 18B-1 and ~~18B2~~ 18B-2. A particularly important inventive feature of this camera process is that it only needs to operate on one data set at time a time, obtained from the LDIP Subsystem 122, in order to perform its complex array of functions. Referring to Figs. 18A, 18B-1 and ~~18B2~~ 18B-2, the real-time camera control process of the illustrative embodiment will now be described with reference to the data structures illustrated in Figs. 19 and 20, and the data tables illustrated in Figs. 21 and 23.

Real-Time Camera Control Process Of The Present Invention

In the illustrative embodiment, the Real-time Camera Control Process 560 illustrated in Figs. 18A, 18B-1 and ~~18B2~~ 18B-2 is carried out within the camera control computer 21 of the PLIIM-based system 120 shown in Fig. 9. It is understood, however, that this control process

can be carried out within any of the PLIIM-based systems disclosed herein, wherein there is a need to perform automated real-time object detection, dimensioning and identification operations.

As illustrated in Figs. 18A, 18B-1 and ~~18B2~~ 18B-2, the camera control process of the present invention has multiple control threads that are carried out simultaneously during each data processing cycle (i.e. each time a new data set is received from the Real-Time Package Height Profiling And Edge Detection Processing Module 550 within the LDIP subsystem 122). As illustrated in this flow chart, the data elements contained in each received data set are automatically processed within the camera control computer in the manner described in the flow chart, and at the end of each data set processing cycle, generates real-time camera control signals that drive the zoom and focus lens group translators powered by high-speed motors and quick-response linkage provided within high-speed auto-focus/auto-zoom digital camera subsystem (i.e. the IFD module) 3'' so that the camera subsystem 3'' automatically captures digital images having (1) square pixels (i.e. 1:1 aspect ratio) independent of package height or velocity, (2) significantly reduced speckle-noise levels, and (3) constant image resolution measured in dots per inch (DPI) independent of package height or velocity. Details of this control process will be described below.

On Page 297, amend paragraph 7 as follows:

At Block D in Fig. 18A, at this stage in the control process, the camera control computer 22 analyzes the height values (i.e. coordinates) buffered in the Package Data Buffer, and determines the current "median" height of the package. At this stage of the control process, numerous control "threads" are started, each carrying out a different set of control operations in the process. As indicated in the flow chart of Figs. 18A, 18B-1 and ~~18B2~~ 18B-2, each control thread can only continue when the necessary parameters involved in its operation have been determined (e.g. computed), and thus the control process along a given control thread must wait until all involved parameters are available before resuming its ultimate operation (e.g. computation of a particular intermediate parameter, or generation of a particular control

command), before ultimately returning to the start Block A, at which point the next time-stamped data set is received from the Real-Time Package Height Profiling And Edge Detection Processing Module 550. In the illustrative embodiment, such data set input operations are carried out every 5 milliseconds, and therefore updated camera commands are generated and provided to the auto-focus/auto-zoom camera subsystem at substantially the same rate, to achieve real-time adaptive camera control performance required by demanding imaging applications.

On Page 298, amend paragraphs 1 and 6 as follows:

As indicated at Blocks E, F, G H, I, A in Figs. 18A, 18B-1 and ~~18B2~~ 18B-2, a first control thread runs from Block D to Block A so as to reposition the focus and zoom lens groups within the auto-focus/auto-zoom digital camera subsystem each time a new data set is received from the Real-Time Package Height Profiling And Edge Detection Processing Module 550.

As indicated at Blocks D, K, L, M in Figs. 18A, 18B-1 and ~~18B2~~ 18B-2, a second control thread runs from Block D in order to determine and set the optimal photo-integration time period ($\Delta T_{\text{photo-integration}}$) parameter which will ensure that digital images captured by the auto-focus/auto-zoom digital camera subsystem will have pixels of a square geometry (i.e. aspect ratio of 1:1) required by typical image-based bar code symbol decode processors and OCR processors. As indicated at Block K, the camera control computer analyzes the current median height value in the Data Package Buffer, and determines the speed of the package (V_b). At Block L, the camera control computer uses the computed values of average (i.e. median) package height, belt speed and Photo-Integration Time Look-Up Table in Fig. 22B, to determine the photo-integration time parameter ($\Delta T_{\text{photo-integration}}$) which will ensure that digital images captured by the auto-focus/auto-zoom digital camera subsystem will have pixels of a "square" geometry (i.e. aspect ratio of 1:1).

On Page 316, amend paragraph 2 as follows:

As shown in ~~Fig. 30~~ Figs. 30-1 through 30-4, the four-sided tunnel-type camera-based object identification and attribute acquisition system of Fig. 27 comprises: a single master PID unit 120 embodying a LDIP subsystem 122, mounted above the conveyor belt structure 571; three slave PID units 120', 120' and 120', mounted on the sides and bottom of the conveyor belt; and a high-speed data communications network 572 supporting a network protocol such as, for example, Ethernet protocol, and enabling high-speed packet-type data communications among the four PID units within the system. As shown, each PID unit is connected to the network communication medium of the network through its network controller 132 (133) in a manner well known in the computer networking arts.

On Page 318, amend paragraph 2 as follows:

In addition, ~~Fig. 30~~ Figs. 30-1 through 30-4 illustrates that the LDIP subsystem 122 within the master unit 120 generates (i) package height, width, and length coordinate data and (ii) velocity data, referenced with respect to the global coordinate reference system R_{global} . These package dimension data elements are transmitted to each slave PID unit 120' on the data communication network, and once received, its camera control computer 22 converts there values into package height, width, and length coordinates referenced to its local coordinate reference system using its preprogrammable homogeneous transformation. The camera control computer 22 in each slave PID unit 120 uses the converted object dimension coordinates to generate real-time camera control signals which automatically drive its camera's automatic zoom and focus imaging optics in an intelligent, real-time manner in accordance with the principles of the present invention. The "object identification" data elements generated by the slave PID unit are automatically transmitted to the master PID unit 120 for time-stamping, queuing, and processing to ensure accurate object identity and object attribute (e.g. dimension/profile) data element linking operations in accordance with the principles of the present invention.

On Page 403, amend the sixth and seventh paragraphs as follows:

In ~~Figs. 69A and 69A1~~ 69A1 through 69B, there is shown a second illustrative embodiment of the novel airport security system of the present invention, indicated by reference numeral 2690.

As shown in ~~Fig. 69A~~ Figs. 69A1 through 69A3, the second illustrative embodiment of the airport security system 2690 comprises a number of primary system components, namely: (i) a Passenger Screening Station or Subsystem 2631; (ii) a Baggage Screening Station or Subsystem 2691; (iii) a Passenger And Baggage Attribute Relational Database Management Subsystems (RDBMS) 2633; and (iv) one or more Automated Data Processing Subsystems 2633 for operating on co-indexed passenger and baggage data captured by subsystems 2631 and 2691 and stored in the Passenger and Baggage Attribute RDBMS 2633, in order to detect possible breaches of security during and after the screening of passengers and baggage within an airport or like terminal system.

On Page 404, amend all paragraphs as follows:

As shown in ~~Fig. 69A~~ Figs. 69A1 through 69A3, the passenger screening subsystem 2631 comprises: (1) a PID/BID bar code symbol dispensing subsystem 2635 for dispensing a passenger identification (PID) bar code symbols and baggage identification (BID) bar code symbols to passengers; (2) a smart-type passenger identification card reader 2675 for reading a smart ID card 2676 having an IC chip supported thereon, as well as a magstripe, and a 2-D bar code symbol (e.g. commercially available from ActivCard, Inc., <http://www.activcard.com>); (3) a passenger face and body profiling and identification subsystem (i.e. 3-D digitizer) 2645; (4) one or more hand-held PLIIM-based imagers 2636; (5) a retinal (and/or iris) scanner 2637 and/or other biometric scanner 2638; and (6) a data element linking and tracking computer 2639. The information produced by subsystems, 122,120, 2637, and 2638 is considered to be "passenger attribute" type data elements. Passenger screening station 2631 may also include a TDS integrated into the system.

As shown in ~~Fig. 69A~~ Figs. 69A1 through 69A3, the PID/BID bar code symbol dispensing subsystem 2635 is installed at a passenger check-in or screening station, for the purpose of dispensing (i) a unique PID bar code symbol 2640 and bracelet 2641 to be worn by each passenger checking into the airport system, and (ii) a unique BID bar code label 2642 for attachment to each article of baggage to be carried aboard the aircraft on which the checked-in passenger will fly (or on another aircraft). Each BID bar code symbol 2642 assigned to a baggage article is co-indexed with the PID bar code symbol 2640 assigned to the passenger checking the article of baggage.

As shown in ~~Fig. 69A1~~ Figs. 69A1 through 69A3, the passenger face and body profiling and identification subsystem 2645, can be realized by a PLIIM subsystem 25, for capturing a digital image of the face, head and upper body of each passenger to board an aircraft at the

airport, or by a LDIP subsystem 122 as a 3-D laser scanning digitizer for capturing a digital 3-D profile of the passenger's face and head (and possibly entire body).

As shown in ~~Fig. 69A~~ Figs. 69A1 through 69A3, the baggage screening station 2691 comprises: an X-radiation baggage scanning subsystem 2650; a conveyor belt structure 2651; and a package identification and attribute acquisition system 120A and an RDIF-tag based object identification device 2693 mounted above the conveyor belt structure 2651, before the entry port of the X-radiation baggage scanning subsystem 2650 (or physically and electrically integrated therein), for automatically performing the following set of functions: (i) identifying each article of baggage 2643 by reading the baggage identification (BID) bar code symbol 2642 applied thereto at the baggage screening station 2691; (ii) dimensioning (i.e. profiling) the article of baggage and generating baggage profile information; (iii) capturing a digital image of the article of baggage; (iv) indexing such baggage attribute data with the corresponding BID number encoded either into the scanned BID-encoded bar code symbol or the scanned BID-encoded RFID-tag applied to each article of baggage; and (v) sending such BID-indexed baggage attribute data elements to the passenger and baggage attribute RDBMS 2633 for storage as a baggage attribute record, as illustrated in Fig. 68B. Notably, subsystem 120A (which receives RFID-tag reader input) performs a "baggage identify tagging" function, wherein each baggage attribute data element is automatically tagged with the baggage identification so that the package attribute data can be stored in the RDBMS 2633 in a way that is related in the RDBMS to other baggage articles and the corresponding passenger carrying the same on board a particular scheduled flight. As shown, the baggage screening subsystem 2691 further comprises a PFNA, MRI and QRA scanning subsystem 2660 installed slightly downstream from the x-ray scanner 2650, with an object identification and attribute acquisition subsystem 120B integrated therein, for automatically scanning each BID bar coded article of baggage prior to screening, and producing visible digital images corresponding to the interior and contents of each baggage article using either PFNA, MRI and/or QRA well known in the bagging screening arts. Such scanning subsystems 2660 can be used to detect the presence of explosive materials, biological weapons (e.g. Anthrax spores), chemical agents, and the like within articles of baggage screened by the subsystem. Baggage screening station 2691 may also include a TEDS integrated into the system.

On Page 405, amend the first full paragraph as follows:

As shown in ~~Fig. 69A~~ Figs. 69A1 through 69A3, the system further comprises a hand-held RFID-tag reader 2695 with a LCD panel 2695A, keypad 2695B, and a RF interface 2695C

providing a wireless communication link to a mobile base station 2696, comprising an RF transmitter 2696A and server 2696B which is operably connected to the LAN in which the RDBMS 2633 is connected. The function of the hand-held RFID-tag reader 2695 is to receive instructions from the Data Processing Subsystem 2634 about the identity and attributes of a suspect passenger and/or articles of baggage, and to use the RFID-tag reader 2695 to determine exactly where the baggage resides in the event of there being a need to access the baggage article and remove it from the baggage handling system or aircraft. During operation, the hand-held RFID-tag reader 2695 generates a RF-based interrogation field which interrogates the whereabouts of a particular BID-encoded RFID-tag 2697 (on an article of baggage). This interrogation process is achieved by generating and locally broadcasting a set of RF-harmonic frequencies (from the RFID-tag reader 2697) which correspond to the natural resonant frequencies of the RF-tuned circuits used to create the BID-encoded structure underlying the RFID-tag. When the suspect baggage resides within the interrogation field of the hand-held RFID-tag reader 2695, an audible and/or visual alarm is signaled from the reader, causing the operator to take immediate action and retrieve the RFID-tag article of baggage from either the baggage handling system or a particular aircraft or other vehicle. Also, the LCD panel of the RFID-tag reader 2696 can access and display other types of attribute information maintained in the RDBMS 2633 about the suspect article of baggage.